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Original communication

Lumbar disc herniation and cauda equina syndrome following spinal manipulative therapy: A review of six court decisions in Canada

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ABSTRACT

The purpose of this review is to expand practitioners' knowledge on areas of liability when treating low back pain patients. Six cases where chiropractors in Canada were sued for allegedly causing or aggravating lumbar disc herniation after spinal manipulative therapy were retrieved using the CANLII search database. The case series involves 4 men and 2 women with an average age of 37.3 years (range, 31–48 years). Trial courts' decisions were rendered between 2000 and 2011. This study highlights the following conclusions from Canadian courts: 1) informed consent is an ongoing process that cannot be entirely delegated to office personnel; 2) when the patient's history reveals risk factors for lumbar disc herniation the chiropractor has the duty to rule out disc pathology as an etiology for the symptoms presented by the patients before beginning anything but conservative palliative treatment; 3) lumbar disc herniation may be triggered by spinal manipulative therapy on vertebral segments distant from the involved herniated disc such as the thoracic spine.

1. Introduction

The practice of chiropractic has changed significantly over the past twenty years. In particular, safety concerns and medico-legal issues of chiropractic therapy have become important topics of discussion in the medical and chiropractic literature. To our knowledge, no previous reports have analyzed the relationship between malpractice litigation and allegations of disc herniation following spinal manipulative therapy (SMT). The purpose of this paper is to analyze factors that have created litigation in this matter in order to help chiropractors better understand their liabilities when treating low back pain patients.

1.1. Low back pain

Low back pain (LBP) is a major health problem throughout the world. Experienced by 70%–80% of the adult population at some time during their lives, it is believed that adults of working age are the most vulnerable to this condition. However studies report that the prevalence of back pain decreases around the middle of the sixth decade.[1] In Canada, it is estimated that medical expenditure on LBP costs between $6 billion and $12 billion annually.[2] Although patients continue in a large measure to seek traditional medical attention, the number of patients who solicit complementary and alternative medicine (CAM) therapies has increased dramatically over the last decade.[3] The most prevalent CAM therapies for back and neck pain in the U.S. are spinal manipulation, acupuncture, and massage.[4] Of note is that almost twenty years ago, the U.S. Agency for Health Care Policy and Research guidelines on back pain recommended the use of spinal manipulation as one important treatment option for LBP.[5] Different sources report that between 9.9% and 12.5% of the Canadian population has consulted with a chiropractor at least once during a given year.[2] In a study that looked at visit rates in 6 cities in the U.S. and Canada, Hurwitz et al. found that 68% of all chiropractic patient visits were for LBP. Of those patients, 45.4% had pain that had been present for less than 3 weeks, while 21.2% had pain that had lasted for over 6 months. Two percent had previous surgery for LBP.[6]

1.2. Tissue-source of low back pain

Studies suggest that low back pain may arise from a number of anatomical structures, including bones, intervertebral discs, joints, ligaments, muscles, neural structures and blood vessels.[7] Intervertebral discs may undergo degenerative changes where mechanical, traumatic, nutritional, and genetic factors all play a role in the cascade of the degenerative process. Lumbar disc herniation

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(LDH) may happen when degeneration, in association with a host of triggering factors, causes localized displacement of nucleus, cartilage, fragmented apophyseal bone, or fragmented annular tissue beyond the intervertebral disc space.[8] The prevalence of LDH in the general population has been estimated at 1–3%.[9] Many reports have shown the spontaneous resolution of LDH, both clinically and on CT scanning.[10] Proposed risk factors for LDH have included degenerative disc disease,[11] genetics,[12] smoking, physical loading such as lifting, driving motor vehicles, vigorous sport activities, industrial work activities[13] and higher body weight and height.[14]

1.3. Spinal manipulative therapy

Spinal manipulative therapy (SMT) is frequently practiced by chiropractors for the management of LBP and can be broadly defined as a manual procedure that involves a high-velocity low-amplitude thrust to move a joint past the physiologic range of motion, without exceeding the anatomic limit.[15] For the purpose of this article, SMT also comprises a diversity of chiropractic technique systems including, for example, mechanically assisted procedures using a moving piece of the treatment table or a percussion instrument which delivers, through a handheld device, a mechanical force to move the spinal functional unit.

Since it is uncommon for patients to have pain only in the lower back,[16] chiropractors may also use SMT on other areas of the body such as the sacroiliac and lower thoracic joints to relieve pain and improve function when treating low back pain patients.

Side posture manipulation is probably the main technique used by Canadian chiropractors to induce movement at the lumbosacral spine (Fig. 1).[17] During this procedure, the chiropractor administers a preload force to rotate the joint to the elastic barrier of the passive range of motion. Then, an impulse load is applied in such a way that the resultant displacement does not exceed the anatomic limit of the articulation. It is thought that at the beginning of the thrust, the intervertebral pressure increases because of the rotational component of the manipulation whereas at the end of the thrust, the intervertebral pressure decreases below the baseline because of the predominance of the traction component.[18] During lumbar spine manipulations, loads transmitted across the body generally remain within the range of the forces generated in common daily tasks.[19]

1.4. Risks of SMT

As with any intervention, there are risks associated with SMT. The majority of adverse events reported in the literature regarding this procedure are benign and transitory. Gouveia (2009) related that 33%–60.9% of patients submitted to spinal manipulations mostly report local discomfort and radiating pain. These symptoms appear frequently in the first hour after treatment and disappear within the first 24–48 h.[20]

Rare but serious complications associated with SMT may also occur. Estimates of the incidence of serious adverse events from published case reports and case series are about 1 event per 1 to 2 million treatments.[20] In general, a higher risk of adverse event is associated with severe spondylitic changes, osteoporosis, fractures, tumors, ankylosing spondylitis, infections or signs of nerve root pressure.[20] In the lumbar spine, safety concerns are related to the risk of manipulation triggering or worsening a herniation and/or causing acute cauda equina syndrome.[21] A Canadian Chiropractic Protective Association claims review for the period 1986–1990 showed that lumbar spine injury comprised 23% of total claims making this type of injury the most frequent cause of litigation in the Canadian chiropractic profession.[22]

Some authors suggest that forces exerted during side posture manipulation of the lumbar spine may change the vertebrae axis of rotation causing a lateral shearing force through the disc and an annular tear.[23] By contrast, others argue that because rotation in the lumbar spine is limited to only 2–3° it is unlikely that a side posture manipulation can injure a healthy disc. Authors hypothesize that the disc must already be fragmented and fissured for spinal manipulation to cause increased symptoms of disc herniation or cauda equina syndrome (see the review by Oliphant, 2004).[23]

SMT to the thoracic spine may be applied with no resultant rotatory or compressive force to the lumbar spine and theoretically does not represent a significant risk to lumbar intervertebral discs. By contrast, ischiatic contact pelvic manipulation to treat sacroiliac joint syndrome (SJD) causes flexion and compression of the lumbar spine and should be avoided in cases of intervertebral disc herniation (Fig. 2).[24]

Safety during lumbar spine manipulation is still a matter of debate in scientific circles and so far no definitive conclusion can be drawn on the level of intervertebral pressure created in humans during side posture lumbar manipulation and the risk of causing or aggravating a disc herniation.

1.5. Standard of care

Courts have established that a medical practitioner has the duty to exercise the degree of care expected of a minimally competent practitioner in the same specialty and under the same circumstances. For chiropractic in particular, the Queen's Bench of Alberta specified that the standard of care is the degree of care, diligence,

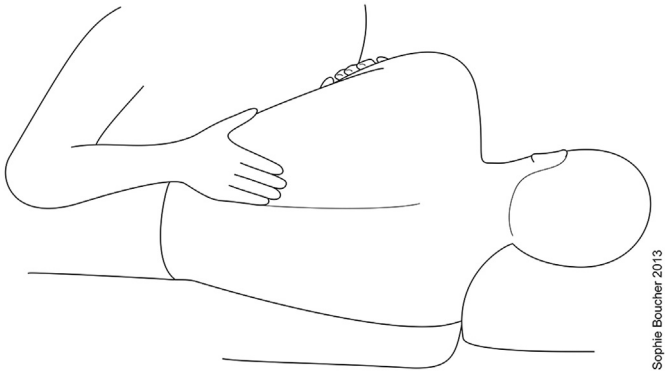

Fig. 1. Side posture lumbar spine manipulation.

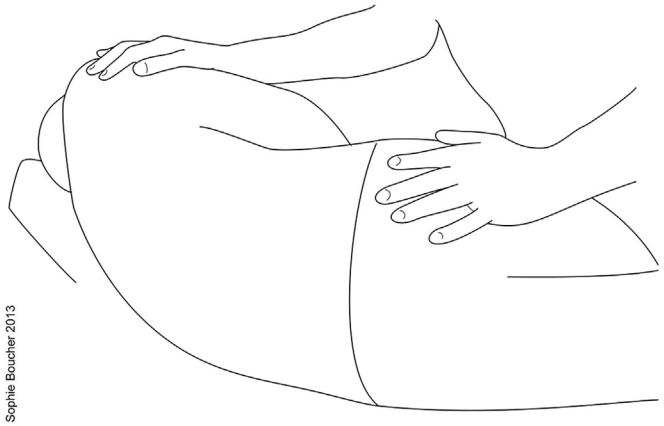

Fig. 2. Side posture ischiatic contact sacro-iliac manipulation.

judgment and skill to be exercised by a normal, prudent or reasonable chiropractor, under similar circumstances and with the same experience and training.[25] In Court, the appropriate measure to evaluate the standard of care is the level of reasonableness determined through the evidence of experts and other relevant sources such as case law, practice guidelines, scientific literature and regulations.

For the purpose of this review, we will briefly discuss the standard of care regarding informed consent, diagnosis and choice or application of chiropractic techniques.

1.5.1. Informed consent

Canadian courts have placed a high standard of disclosure on health care professionals. Over twenty years ago, the Supreme Court of Canada ruled that patients should be told what the medical practitioner intends to do, as well as what the significant material risks are and anything else that a reasonable person in that patient's condition would want to know.[26]

More recently, in a chiropractic malpractice case, the Court of Queen's Bench of Alberta specified that a medical practitioner must inform a patient about certain key facts: 1) the diagnosis of the patient's condition; 2) the prognosis of that condition with and without treatment; 3) the nature of the proposed treatment; 4) the risks associated with the proposed treatment and 5) the alternatives to the proposed treatment, and the advantages and risks of those alternatives.[27] The Court of Appeal of Alberta reminded that not every conceivable material risk must be disclosed, but rather, what must be considered is the degree of probability of the risk and its seriousness in each case.[28]

The procedure by which the consent is to be obtained has also been the subject of courts decisions. Pertinent to this case series is the fact that, by case law, a medical practitioner cannot delegate the task of obtaining informed consent to an office staff in cases where the patient is asked to read and sign a standard form.[29]

1.5.2. Diagnosis

The Court of Appeal of Alberta reminded that the standard of care imposed upon medical practitioners, including chiropractors, applies not only to the treatment given to patients but also to the diagnosis.[25] The duty to diagnose includes the taking of a thorough history and the conducting of proper examination, tests, and consultations with colleagues and specialists when necessary. In doing so, a practitioner will adequately follow the methods characteristic of the health care school of which he is a member.[25] Provided the school of health itself does not fall below the standard of care, courts increasingly accept that diagnoses may legitimately vary among systems of health care on the basis of different principles.[30]

A medical practitioner must control for the validity of his diagnosis as the treatment progresses. An apparent failure of the treatment should be followed by careful re-evaluation to avoid proceeding blindly.[28]

1.5.3. Choice or application of technique

Chiropractic techniques that are taught in Council on Chiropractic Education accredited colleges are recognized in Canada. When treating patients, the chiropractor must, at each visit, evaluate them and choose the appropriate technique according to their age, condition and deficiencies. The application of the technique must also be tailored to the patients' particularities. When using SMT, the chiropractor must adjust the parameters of direction, amplitude and velocity to deliver the manipulation in a safely manner.

1.6. Judicial decisions

The law is often solely viewed as a control system but it may also be a learning resource. Adverse events after chiropractic care have been frequently described in case studies and case series. Unfortunately, this type of reports often times has lacked proper documentation and, at times, has led to quick judgements obscuring a more complex truth.

Court opinions may offer insights usually not available in case reports or case series. In chiropractic, details regarding manipulative therapy such as the type of technique used, anatomical areas treated, number and frequency of treatments as well as temporal relationships between treatment and adverse events are very important when attempting to evaluate standard of care and establish causation. Court opinions often provide these kinds of details and allow a much better comprehension of the cases. The understanding of what went wrong and why may help decrease the likelihood of future incidents.

2. Materials and methods

The CANLII search database was used to identify cases where chiropractors in Canada were sued for allegedly causing or aggravating lumbar disc herniation after spinal manipulative therapy. CANLII is a legal search database that provides access to court judgments, tribunal decisions, statutes and regulations from all Canadian jurisdictions. The database was searched for the following terms: *chiropractor*, *manipulation*, *disk*, *disc* and *herniation*. A search in the French language was also performed using the terms *chiropraticien*, *manipulation*, *disque* and *hernie*. The searches yielded a total of 52 decisions (32 English, 20 French). All selected decisions were then individually reviewed to specifically identify cases where chiropractors were accused of malpractice for causing or aggravating lumbar disc herniation. Following this review, 5 decisions were selected. Moreover, when available, courts' electronic databases of all Canadian provinces and territories were also searched using the same terms. Results were cross-referenced with those obtained with the CANLII search. The review allowed the retrieval of 1 additional case. A total of 6 cases were thus selected for the present study.

3. Results

3.1. Demographics

The case series involves 4 men and 2 women with an average age of 37,3 years (range, 31–48 years). All patients consulted with their chiropractors for an episode of acute low back pain without any objective neurological impairment observed at the first consultation.

3.2. Risk factors

The following risk factors are represented in the case series: lifting ($n = 4$); smoking ($n = 2$); degenerative disc disease ($n = 2$); physical injuries ($n = 1$); physical loading ($n = 2$). In the last category, one patient was pregnant and the other was obese. Every patient had at least one premorbid risk factor and lifting was the most frequent risk factor noted.

3.3. Spinal manipulative therapy

All patients in this series received manipulative treatment for SJD (side posture SMT, $n = 4$; SMT with percussion instrument, $n = 1$; technique not reported, $n = 1$). Three patients received SMT

Table 1
Cases and patients' demographic data with summary of clinical information.

CasePatient's sex/age	Patient's antecedents	Reason to attend with the defendant chiropractor	Chiropractor's main findings	Neurological signs at first visit	Anatomical level: technique used at the time of the adverse event	Total number of chiropractic treatments received	Post SMT signs and symptoms
R.B. vs G.M.M/38	- 10′ fall out of a tree; - Motor cycle accident; - 10′ fall off a ski lift chair; - Sporadic back pain.	Spontaneous acute episode of thoracic and lumbar pain. After resolution of the acute episode, the patient was then treated regularly by his chiropractor for maintenance care.	- C1 fixation; - T4 fixation; - Left sacroiliac fixation.	None	- C1: n/a; - T4: supine thrust manipulation (diversified "anterior" adjustment); - Sacroiliac joint: side posture thrust manipulation.	35 (over a period of 3 years)	Immediate acute back pain radiating down the left leg after T4 manipulation of the last treatment.
L.N. vs H.B.F/34	- Two pregnancies; - Weight gain.	Residual low back stiffness since the last pregnancy (time before consulting with chiropractor not specified)	Joint dysfunctions at thoracic, lumbar and sacroiliac joints.	None	- T12: sitting thrust manipulation[a]; - L1 to T3: n/a; - L3: n/a; - Sacroiliac joint: side posture (no further detail).	9	Immediate back pain after T12 thoracic manipulation of the 4th treatment.
T.W. vs G.Z.M/35	- Degenerative lumbar disc disease; - Heavy lifting.	Acute low back pain after changing tires on his car. Patient consulted chiropractor 5 months after the incident for sporadic flare-ups of residual low back pain.	- Joint dysfunctions at T12-L1; - acute bilateral sacroiliac fixations.	None	- T12-L1: n/a; - Sacroiliac joints: bilateral side posture thrust manipulations.	5	1 day after the last treatment, patient experienced tightness in calves, numbness in left heel and spasms down the legs.
I.M. vs M.S.M/38	Heavy lifting.	Acute low back pain after pulling a heavy load at work. Patient consulted chiropractor 1 day after the accident.	Sacroiliac sprain.	None	- Electrotherapy over low back; - Sacroiliac joints: bilateral side posture thrust manipulations.	3	Saddle anesthesia 48 h after the last treatment.
M.R. vs K.M.F/48	- Disc herniation at L4-5 (surgery); - Disc herniation at L5-S1 (surgery); - Smoking; - Lifting.	Acute low back pain after lifting a child. Patient consulted chiropractor 3 weeks after the incident.	Back sprain and sacroiliac sprain.	None	- Pelvic musculature: stretching of gluteal muscles and piriformis; - Sacroiliac joints: right and left sides (technique not specified); - L4 and L5: side posture thrust manipulations (lateral processes pushes).	3	Immediate burning pain in the back after 2nd treatment (precise location of pain not specified).
P.B. vs M.P.M/31	- Obesity; - Smoking; - Sedentary occupation; - History of low back pain related to heavy lifting.	Acute episode of low back pain after sitting on a coach. Patient consulted chiropractor immediately after the incident.	Acute left sacroiliac syndrome.	None	Sacroiliac joint: prone mechanical percussion on the left side.	1	Urinary incontinence approximately 12 h after the treatment.

[a] Deduction made by the authors, see Section 3.3 of the text.

Table 2
Treatment and post SMT signs and symptoms.

CasePatient's sex/age	Anatomical level: technique used at the time of the adverse event	Total number of chiropractic treatments received	Post SMT signs and symptoms	Additional neurological signs: Time to onset
R.B. vs G.M.M/38	- C1: n/a; - T4: supine thrust manipulation (diversified "anterior" adjustment); - Sacroiliac joint: side posture thrust manipulation.	35 (over a period of 3 years)	Immediate acute back pain radiating down the left leg after T4 manipulation of the last treatment.	Left foot drop: 1 day
L.N. vs H.B.F/34	- T12: sitting thrust manipulation[a]; - L1 to T3: n/a; - L3: n/a; - Sacroiliac joint: side posture (no further detail).	9	Immediate back pain after T12 thoracic manipulation of the 4th treatment.	Right foot drop: 14 days
T.W. vs G.Z.M/35	- T12-L1: n/a; - Sacroiliac joints: bilateral side posture thrust manipulations.	5	1 day after the last treatment, patient experienced tightness in calves, numbness in left heel and spasms down the legs.	Absent left ankle reflex: 14 days
I.M. vs M.S.M/38	- Electrotherapy over low back; - Sacroiliac joints: bilateral side posture thrust manipulations.	3	Saddle anesthesia 48 h after the last treatment.	None
M.R. vs K.M.F/48	- Pelvic musculature: stretching of gluteal muscles and piriformis; - Sacroiliac joints: right and left sides (technique not specified); - L4 and L5: side posture thrust manipulations (lateral processes pushes).	3	Immediate burning pain in the back after 2nd treatment (precise location not specified).	Decreased sensations in right L5-S1 distribution and absent right ankle reflex: 3 days
P.B. vs M.P.M/31	Sacroiliac joint: prone mechanical percussion on the left side.	1	Urinary incontinence approximately 12 h after the treatment.	None

[a] See Section 3.3 of the manuscript for explanation.

on the lumbar spine (SMT side posture $n = 1$; unknown technique $n = 2$). Three patients received thoracic manipulation and one patient, cervical manipulation.

One case of thoracic manipulation brought some controversy over the technique used prior to the adverse event.[31] In court, the patient related she was sitting on the treatment table, legs spread out when the chiropractor manipulated her dorsal spine. The chiropractor held she used the supine anterior thoracic manipulation technique and did not manipulate the patient's dorsal spine with her legs spread out in front of her. However, based on the credibility of the witnesses, the judge rejected the chiropractor's version as to how the manipulation was performed. Here is a citation from the court's decision which describes how the patient depicted the treatment given by the chiropractor:

> *[16] On September 4, 1999, Mrs. N. said that Dr. B. examined her and did one manipulation. Mrs. N. said, "She asked me to sit on the table, legs out, arms across my chest." She described the process as follows:*
>
> > *"I felt her hands on my upper back and one lower down. I was as far forward as I could go. I was not warned. She said, "Take a deep breath and let it out." She would do it quickly. I felt something went in my back. I said, "I didn't like that."*

SMT of the dorsal or lumbar spine in a sitting position is possible. However, the description given by the patient does not correspond to any chiropractic technique known to the authors of this review. Because anterior thoracic manipulations are common among chiropractors it is highly likely that the technique used was, in fact, a supine manipulation and not a sitting manoeuver as described by the patient.

3.4. Post SMT signs and symptoms

In this series, post manipulation signs and symptoms included local back pain ($n = 3$); leg pain and/or paresthesia ($n = 2$); saddle anesthesia ($n = 1$) and urinary incontinence ($n = 1$). Half of the incidents occurred immediately after the SMT ($n = 3$). The other half occurred between 12 and 48 h after the SMT ($n = 3$). Clinical pictures of patients, treatments and incidents are shown in Table 1.

3.5. Clinical evolution

Four patients developed additional neurological deficits between 1 and 14 days after the appearance of the initial signs and symptoms. These signs included foot drop, diminished ankle reflex and decreased skin sensitivity. Five patients have had back surgery. At the time of trial, which vary from 2 to 10 years after the events (average = 7 years), five patients reported suffering from permanent disability. Evolution of patients' signs and symptoms are shown in Table 2. Final outcomes are shown in Table 3.

3.6. Standard of care

In three cases, the courts found that the defendant chiropractors met the standard of care required for a chiropractor at the time of the events. In the three remaining cases the courts found the chiropractors negligent over one or several elements of chiropractic practice: 1) procedures used in obtaining informed consent ($n = 2$), 2) diagnosis/re-evaluation ($n = 2$) and 3), choice or application of technique ($n = 2$).

3.6.1. Informed consent

Failures concerning informed consent were found in 2 cases. First, in Malinowski v. Schneider (2010),[28] the trial court found that the informed consent form signed by the patient did not, on its own, discharge the chiropractor's duty to inform. Besides, the chiropractor failed to 1) ensure that the patient understood the meaning of the words and expressions as well as the overall meaning of the document, and 2) disclose special or unusual risk that ought to have been disclosed prior to the treatment. Furthermore, according to the Court, the chiropractor minimized the "special and unusual" risks of chiropractic, and put inappropriate emphasis on the most serious potential consequences of alternatives to chiropractic treatments.

Table 3
Diagnosis and outcomes.

Case	Time to imaging	Lesion	Outcome
R.B. vs G.M.	22 days	Sequestrated L4-5 disc herniation	- Back surgery with chronic recurrent mechanical low back pain. - Partial permanent disability.
L.N. vs H.B.	Not specified	L5-S1 disc herniation	Chronic pain and weakness
T.W. vs G.Z.	Not specified	L5-S1 disc herniation	Two back surgeries with residual permanent incapacity and chronic pain
I.M. vs M.S.	Not specified	L3-4 disc herniation with cauda equina syndrome	Back surgery with residual permanent incapacity and chronic pain
M.R. vs K.M.	27 days	L4-5 disc herniation	Two back surgeries. Sequelae not specified.
P.B. vs M.P.	Approximately 36 h	L3-4 disc herniation with cauda equina syndrome	Back surgery with residual permanent incapacity (between 24 and 42%)

Second, in Reid v. Maloney (2010),[25] the trial court held that the chiropractor failed to advise sufficiently the patient on the nature and on the risks of the proposed treatment.

3.6.2. Diagnosis/re-evaluation

Failures were found in 2 cases. In Reid v. Maloney (2010), the court found that the chiropractor failed to obtain details of the patient's history of degenerative disc disease and previous back surgeries. Furthermore, the chiropractor failed to complete more extensive testing and examination. According to the court, both failures did not enable him to rule out lumbar disc herniation as the cause of the patient's pain. In Malinowski v. Schneider (2010), the trial court found that the chiropractor took no step to determine whether he had aggravated a disc injury when he manipulated the patient's spine during the previous visit.[28]

3.6.3. Choice or application of technique and causality

In 4 cases, the courts established a causal relationship between SMT and the adverse events. Surprisingly, adverse events occurred in 2 cases where chiropractors used what is referred to an anterior thoracic manipulation. In this type of manipulation the patient lies on his back. In the setup procedure, the chiropractor places his hand under the patient's dorsal spine and then uses a body drop to deliver the thrust to the targeted joint. Fig. 3 illustrates the procedure. Note that the patient is slightly rotated to the right to show the chiropractor's contact hand.

In Balcom v. MacDonald (2000), the Court did not question the choice or the application of the technique employed but nevertheless found a causal relationship between the anterior thoracic manipulation and the onset of the patient's foot drop.[32] In Nobel v. Bergstrom (2001), the Court found that the anterior thoracic manipulation done at the T12 vertebra was improperly applied and deviated from the standard of care.[31] Authors' concerns regarding this issue have been expressed in Section 3.3 of this article. Considering the text of the judgment, it is also the authors' point of view that, even in the absence of error in the choice or application of the technique, the court would have found that the force exerted during the treatment would have cause the patient's symptoms.

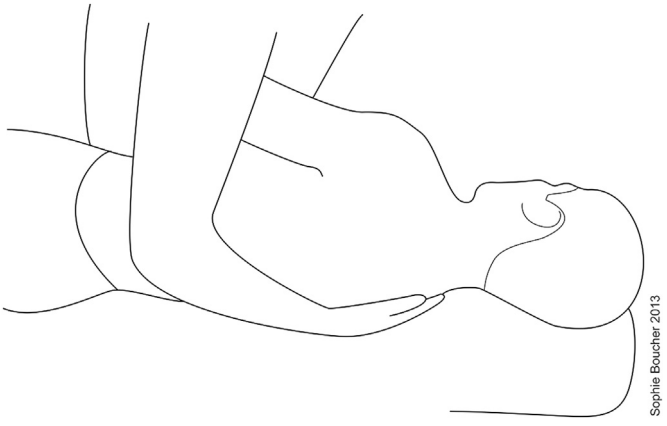

Fig. 3. Supine anterior thoracic manipulation.

In Malinowski v. Schneider (2010), the trial court did not question the technique used by the chiropractor, but found that the adverse event was caused by the force produced during delivery of the sacroiliac manipulations.[28] In Reid v. Maloney (2010), the court found that the adverse events were caused by the side posture L4-L5 manipulations.[25]

Courts' opinions on standard of care and causality are shown in Table 4.

3.7. Expert testimony

Chiropractors appeared as expert witnesses on behalf of both plaintiffs and defendants in a proportion of 13:7 favoring the defense. Non-chiropractors, that is 8 medical specialists and 1 physical therapist, provided testimony in a proportion of 9:1 favoring the plaintiff.

Chiropractors provided opinions in matters of standard of care and causation. All medical specialists and the physical therapist provided opinion on causation. Furthermore, 4 medical specialists out of 8 (1 in rehabilitation medicine; 2 in orthopedic surgery; 1 in neurosurgery) also provided opinions on the standard of care of chiropractors. Although courts have recognized that an expert in a given subject cannot comment on the expertise of a different discipline, Canadian appellate courts have determined that a specialist can provide evidence on the standard of care of a general practitioner such as a chiropractor.[28] The admissibility of the specialist's opinion depends on the subject matter on which that opinion is offered and the specialist's training and experience.

Review of the 6 courts' decisions revealed that the specialists provided opinions on indications, contraindications and safety of SMT, informed consent and clinical management of disc herniation. None of the courts' decisions provided any indication as to whether the medical experts had any special training or experience in chiropractic or SMT.

4. Discussion

4.1. Legal requirements

To be successful, a medical malpractice claim must meet four conditions: 1) a duty existed between the patient and the practitioner, 2) the duty was breached, 3) the plaintiff was injured, and 4) the breach reasonably led to the injury. Typically, if the plaintiff proves on a balance of probabilities that, but for the defendant's breach, the loss would not have occurred, then the causation element has been met.

4.2. Clinical insights

In this series, common clinical findings made by the treating chiropractors were the following: 1) all patients presented with

Table 4
Allegations against the defendant chiropractors, courts' opinions regarding standard of care issues and final courts' decisions.

Case	Allegations against the defendant chiropractor	Informed consent	Initial diagnosis	Choice of manipulative technique or other treatment	Application of treatment	Diagnosis/ re-evaluation	Causality	Decision in favor of
R.B. vs G.M.	Failure to obtain informed consentNegligence consisting of inappropriate diagnosis and treatment causing or contributing to a sequestrated lumbar disc	No negligence	No negligence	No negligence	No negligence	Not an issue	Causal relationship	Defendant
L.N. vs H.B.	Inappropriate application of a treatment	Not an issue	Not an issue	Not an issue	Negligence	Not an issue	Causal relationship	Plaintiff
T.W. vs G.Z.	Negligence consisting of inappropriate diagnosis, treatment and failure to recognize a disc herniation	Not an issue	No negligence	No negligence	No negligence	No negligence	No causal relationship	Defendant
I.M. vs M.S.	Negligence consisting of - adequacy of his disclosure of risks from chiropractic treatment and of non-chiropractic alternatives inappropriate diagnosis, inappropriate treatment	Negligence	No negligence	No negligence	No negligence	Negligence	Causal relationship	Plaintiff
M.R. vs K.M.	Failure to properly diagnose, obtain consent and properly treat	Negligence	Negligence	NegligenceThe chiropractor	Not an issue	Not an issue	Causal relationship	Plaintiff
P.B. vs M.P.	Inappropriate diagnosis, choice of treatment and execution of the treatment	Not an issue	No negligence	No negligence	No negligence	Not an issue	No causal relationship	Defendant

acute uncomplicated low back pain; 2) all patients received treatment for sacroiliac joint dysfunction and, 3) all patients developed symptomatic disc herniation after SMT performed either at dorsal, lumbar or sacroiliac joints.

4.2.1. Acute uncomplicated LBP

At presentation, all patients showed symptoms of acute uncomplicated low back pain. This condition can be defined as pain with no symptoms or signs suggestive of any specific underlying pathology such as infection, tumor, osteoporosis, fracture, structural deformity, inflammatory disorder, radicular syndrome, or cauda equina syndrome. Various structures of the spine could constitute the origin of low back pain in accordance with their innervation, but the clinical interpretation of abnormalities is not possible on the basis of anatomical data alone.[33] A review of all possible causes of LBP is not within the scope of this article, therefore the remainder of the discussion will focus on sacroiliac joint dysfunction and disc degeneration.

4.2.2. Sacroiliac joint dysfunction (SJD)

SJD has been acknowledged as a cause of localized back pain or even pseudoradicular pain (see the review by Dontigny, 1990).[34] SJD may be the result of direct trauma, pelvic shear, torsional forces, inflammation or idiopathic onset.[35] It can be easily confused with conditions such as lumbar disc herniation, lumbar spinal stenosis and facet joint syndrome, which have a similar pain pattern.[36] Manipulative therapy is an intervention commonly used in the treatment of individuals with SJD and has been described in the chiropractic, medical and physical therapy literature.[35]

4.2.3. Disc degeneration

Disc degeneration involves structural disruption and cell mediated changes in composition. The etiology of pain appears to be a combination of mechanical deformation and the presence of inflammatory mediators. Disc degeneration has a very high prevalence in the asymptomatic population so that by the age of 50, 85%–95% of adults show evidence of degenerative disc disease at autopsy.[8]

Lumbar discs may refer pain to the sacroiliac joints. For example, it has been shown that an L5-S1 disc can cause sclerotodermal referred pain with hypersensitivity to the sacroiliac area as depicted in Fig. 4. Examples are redrawn from Hyodo (2005).[37]

Pathologies and/or dysfunctions at both the lumbar disc and sacroiliac joint levels may coexist. For example, Irwin and Harris (2004) present two LBP patients with lumbar disc herniation who were also found with SJD.[38] Both patients failed to respond to transforaminal epidural steroid injections but reported significant relief after anesthetic blocks of the sacroiliac joints. Patients presenting this combination of problems represent a diagnostic challenge when attempts are made to find which structure constitutes the pain generator.

4.2.4. Diagnosis

For first contact clinicians such as chiropractors it is difficult to establish with certainty the source of the pain in the majority of cases of LBP. The reason is that only a small amount of investigation has been performed into the diagnostic accuracy of clinical tests used by general practitioners to identify the tissue-source of low back pain. Thus, the usefulness of these tests remains unclear.[38] Furthermore, functional disorders in general, and dysfunction of the sacroiliac joint in specific, cannot be detected by CT or MRI.[39] In day to day practice, practitioners may face a dilemma when valid and accurate differential diagnosis is typically not possible.

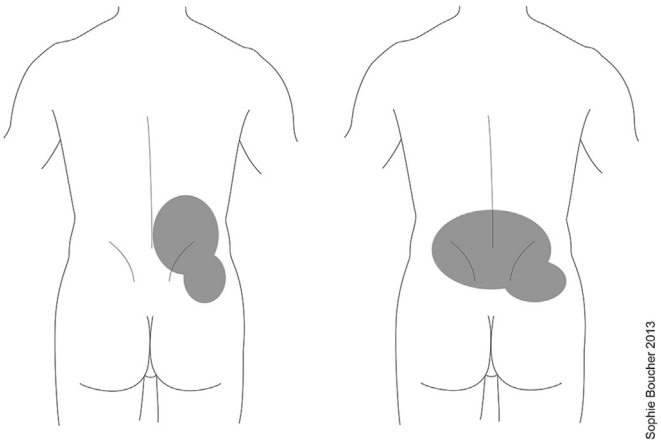

Fig. 4. Sclerotodermal referral patterns from L5-S1 disc.

4.3. Failures

Failures that led to a verdict of negligence have included informed consent, diagnosis and choice or application of manipulative technique.

4.3.1. Informed consent

Most legal actions involving chiropractors are based on claims of negligence and often times raise questions about the adequacy of the consent discussion with the patient. Best practice guidelines published in the medical or chiropractic literature provide the practitioner with general guidance, however, the legal test for whether the informed consent standard is met is that set out in the case law rather than in practice guidelines or professional associations policies.[25] Case law has clearly established that a medical practitioner, including a chiropractor, cannot fulfill his duty to obtain informed consent simply by having the patient sign a standard written document; it rather is a process that must engage with the needs of a particular patient. As the Alberta Court of Appeal held: "A process undertaken in one circumstance may be found to be informed where in another it might not".[42] For example, in Malinowski v. Schneider (2012), the Court of Appeal of Alberta reminded that what is considered material, special or unusual risk and what should be disclosed to patients is context dependant.[28] In that case, the chiropractor had not ruled out the possibility of disc herniation and this failure created the context upon which the disclosure had to be made.

In relation to LBP, chiropractors who intend to use SMT must advise patients of alternative treatments especially if they present with risk factors for disc herniation and more specifically, history of discal surgery.

Several methods exist to provide and document informed consent. Educational brochures and videos are examples of extremely useful tools for increasing the patient's understanding of his condition and the proposed procedure. The patient may also be given a written consent form to read before the encounter with the chiropractor. Although staff members may provide patient information, the ultimate responsibility for verifying informed consent rests with the chiropractor and must include a discussion with the patient.

4.3.2. Diagnosis

Failure to diagnose is a frequent allegation in legal actions against chiropractors in Canada and courts have highlighted the importance of adequate history and of patients' examination prior to giving care. More specifically for LBP patients, when the history reveals risk factors such as disc surgeries, spinal meningitis, smoking and degenerative disc disease and when the chiropractor intends to use SMT, he has the duty to rule out disc pathology as an etiology for the symptoms presented by the patients before beginning anything but conservative palliative treatment.[41]

The establishment of a diagnosis is an ongoing process where the chiropractor must continually reassess the patient's condition every time new elements suggest that the patient's condition does not progress satisfactorily. The reassessment must also be comprehensive enough to include all important elements to test for the possible emergence of a more serious condition than the one initially diagnosed.[42]

4.3.3. Choice of treatment for patients at risk of lumbar disc herniation

Based on experts' opinions, Canadian courts have accepted that thrust manipulation of the thoracolumbar spine or of the sacroiliac joints has the potential to aggravate a lumbar disc herniation. In Malinowski v. Schneider (2010), the Court of Queen's Bench of Alberta ruled that the standard of care for a chiropractor in Canada required the practitioner treating a person with a possible intervertebral disc injury not to conduct spinal manipulation until that patient rested for two to three days.[41] Commenting further on this case, the Court of appeal of Alberta (2012) agreed with the trier of fact that in that particular instance, other available courses of treatment should have been employed instead of SMT.[28]

Numerous non-SMT techniques and adjunctive therapies are available to chiropractors, which all can be used in association with palliative home regimen such as rest and ice to begin treatment of patients at risk. The choice of applying SMT on joints at some distance of the lumbar spine (ex: lower thoracic spine) does not protect the patient nor the chiropractor of adverse events involving lumbar discs. SMT technique that flexes and compresses the lumbar spine should be avoided in patients with LDH. When an intervertebral disc is so damaged that it is on the verge of herniation, even a slight force transmitted to the disc through the spine and soft tissues has the possibility of triggering the herniation.

4.4. Causality

Determination of causation addresses cause and effect between the breaches of care and the patient's injuries.[25] In establishing causation, the general question that courts have to answer is: but-for the defendant's act, would the patient have suffered the injuries? To answer that question, courts use expert opinions and apply the information provided to the facts and circumstances of the case.[25]

4.4.1. Scientific and clinical evidence

In this series, expert witnesses provided information on different scientific issues. First, defendants' and plaintiffs' experts agreed that no large scale epidemiological study has yet been conducted to help understand the relationship between disc herniation and SMT.[42] Second, defendants' chiropractic experts provided information gained from biomechanical studies suggesting that forces deployed during SMT were largely dissipated in different tissues of the body such that only 2% of the force developed by the chiropractor would be experienced by a lumbar intervertebral disc.[25,42] Moreover, the rather high load resistance of lumbar intervertebral discs and anatomical properties of the lumbar facets joints would also prevent injury during SMT.[42] In sum, defendants' experts submitted that no study has ever provided scientific proof that SMT is a cause of

LDH. Besides, and using this same line of thought, it was suggested that forces exerted during SMT are so slight that they would be unlikely to play a significant role in the triggering of disc herniation.[42]

Plaintiffs' experts countered that research done on cadaveric and animal models had little relevance to the forces and stresses experienced by intervertebral discs in live humans. In Malinowski v. Schneider (2010), the trial court gave a representative response to these conflicting opinions:

> *"To a large degree the various testimony on the exact amount of force that is experienced by the L3-L4 intervertebral disc during a chiropractic sacroiliac manipulation, such as that performed by Dr. Schneider, is irrelevant. All experts agreed that a chiropractic adjustment involves application force to a part of the spine. Chiropractic techniques involve adequate force to externally manipulate the patient's spinal structures, which is evidenced in part by consequences such as cavitation sounds, but also by the accepted fact that sometimes chiropractic techniques can inadvertently injure patients. There was no dispute that the sacroiliac joint, the target of the therapy, is an anatomically strong and stiff structure, so an effective manipulation of that joint must involve non-trivial forces on that structure."*[42]

In sum, the trial court based its opinion on the accepted facts that significant forces are involved during SMT and that these forces have the potential to cause injuries. Measurements of force in live humans during SMT are still a matter of scientific debate and currently, no solid data exist which could help courts better understand how those forces act on an already injured lumbar intervertebral disc.

4.4.2. Facts and circumstances

In establishing causation, courts have discussed other factors, mainly temporal relationships and the existence of alternate explanations to SMT as triggers of LDH.

It is of general knowledge that the closer the temporal relationship between a medical act and an adverse event, the higher the probability of a causal link between that medical act and the patient's injury. However, courts have acknowledged that the temporal aspect constitutes only one factor of causation and is not always reliable.[42] The courts must identify all possible explanations for the patient's injuries and determine their most likely cause. In this series, daily activities have been accepted by both defendants' and plaintiffs' experts as possible alternate causes for aggravating factors of LDH.

In this matter, the patient's testimony constitutes a very important factor in causality determination since he/she may be the only person to know whether a mechanical event such as a sneeze or cough has happened between the defendant's act and the onset of symptoms. The patient may simply not remember, or has not established a link between the trivial event and his/her symptoms. In a context of litigation, a patient could also be tempted to attribute his/her injury to a particular event. In Wallace v. Zradicka (2006), the court gave much consideration to opinions formulated by authors Ian MacNabb and John McCulloch with regards to this possible behavior[43]:

> *"[76] While under re-examination Dr. Aitken testified that the chiropractic adjustments subjected the plaintiff's lumbar spine to "repetitive trauma" but this opinion is somewhat marginalized when viewed against the publication "Back Ache", 2d. ed., authored by Doctors Ian MacNabb and John McCulloch. At p. 284 of that publication the authors state as follows:*
>
> *…However, most patients with a disc rupture will have experienced some degree of prodromal back pain for varying lengths of time (from minutes to years)…*
>
> *Approximately half of the patients will attribute their back pain to various forms of traumatic experience. This is especially prevalent in the litigation and compensation population but, in fact, is retrograde rationalization on the part of many patients. Experimental studies and careful statistical analysis of case histories [13] do not support the concept that direct trauma or sudden weight loading of the spine are the causal agents of disc rupture, although they may aggravate a pre-existing lesion.*
>
> *Either in a gradual or sudden fashion, the pain will lateralize to the hip or leg. This moment of lateralization heralds the contact of the ruptured disc with the nerve root and may or may not be precipitated by a simple traumatic event, such as bending over in the shower to pick up the soap.*
>
> *[Emphasis added]"*

The court then goes on:

> *"[77]Thus, it is clear from this extract of Dr. MacNabb's text that any "trivial trauma" brought about via the activities of daily living could possibly bring about this phase of the symptoms of lumbar disc disease. Up until May 1st the repetitive trauma opined by Dr. Aitken consisted of three treatment sessions which Dr. Aitken agreed were safe even given the incipient herniation of the disc. It is difficult to understand why the shifting of symptoms from the midline to the left side is best explained by the chiropractic adjustments performed by Dr. Zradicka and not by any other everyday activity undertaken by Mr. Wallace on April 28, 29 or 30 as contemplated by the authors of "Back Ache"."*

In this particular case, the court concluded that no factual element could isolate the role of the chiropractic treatment as a trigger to the patient's symptoms and found no causal relationship.

In Malinowski v. Schneider (2010) however, the trial court had another view regarding the identification of alternate causes[42]:

> *"[280]…5. If rest usually results in lumbar intervertebral disc injury/herniation recovery, and here there was a further disc injury that led to the ejection of the nucleus pulposus, then logically, absent a better alternative, an external force with the known potential to cause disc herniation of an already weakened disc is the more probable cause of Mr. Malinowski's injury. That was the chiropractic adjustments."*

Here, the court did not consider daily activities as a potential cause for the patient's injuries the way the trial court did in Wallace v. Zradicka (2006).[43] This court's opinion may be explained by the fact that the patient was in such pain that he had to take complete rest and restrict all daily activities. Under those circumstances, the court may have concluded that no significant event has occurred that could have worsened the injury. The credibility of expert witnesses may be another factor that may have influenced the analysis made by the court. For example in Reid v. Maloney (2010) the court stated[25]:

> *"I accept the evidence of Dr. L that in most cases there is a trigger mechanism; to assume, that Mrs. Reid's back injury was simply spontaneous is to ignore the temporal aspect of her pain."*

Here the court seemed to ignore daily activities as possible trigger events. The view may be explained by the greater weight

granted to the opinion of the plaintiff's expert (Dr. L) than to the opinion of the defendant's expert (Dr. E):

> *"As an orthopaedic surgeon, Dr. L has had vast experience and has doubtless taken or reviewed a patient history for every patient on whom he has operated for disc injury. As a result of his experience, Dr. L is in a much better position to provide opinion evidence about the causal link between a precipitating event and disc injury than is Dr. E who bases his opinion on one study…"*

Characterized by a greater credibility than the defendant's expert, the plaintiff's expert was able to convince the court that an identifiable trigger, other than the ones produced during ordinary daily activities, is usually present in LDH. Based on this opinion and contrary to opinions formulated in Wallace v. Zradicka (2006), the court found that the patient's symptoms were best explained by the chiropractic treatment and not by any other everyday activity undertaken by the patient.[44]

Biomechanical data available in the period of time covered by this series was derived from cadaveric and animal models. Interpretation of data was extrapolated to live humans by defendants' experts to suggest that SMT does not have the potential to cause or aggravate LDH. This approach was not deemed appropriate by trial courts which found that this kind of reasoning was too speculative. When a causal relationship was found, courts agreed that forces exerted by the chiropractors during the manipulations, even if no more significant than the effect of a sneeze or cough, had the possibility of aggravating an intervertebral disc injury, including disc herniation. If analysis of the facts shows that the patient's symptoms are not best explained by any other trigger mechanism than the manipulation, then the court is likely to find a causal relationship between the chiropractic treatment and the adverse event.

According to case law, SMT conducted to dorsal spine, lumbar spine or sacroiliac joints constitute a risk of aggravating a pre-existent disc injury.

5. Limitations

The current analysis has a number of limitations. First, the CANLII database was created in 2000 and is therefore a fairly recent search instrument. Some Canadian judicial decisions published before 1990 may not be available with the exception of decisions of the Supreme Court of Canada which date back to 1907. Second, database search does not capture cases involving a confidential settlement or that have been abandoned. Third, inaccurate reporting by patients and practitioners is possible due to the adversarial nature of litigation. However, sworn testimony under penalty of perjury offers a source of information that may be superior in reliability to any other type of data collection.

6. Conclusion

This analysis aims to expand practitioners' knowledge on areas of liability when treating LBP patients. With acute nonspecific low back pain patients, practitioners should consider disc herniation as a differential diagnosis when risk factors are documented in the patient's history, despite the absence of any objective neurological signs during physical examination. LDH is known to occur in different ways, either spontaneously, after common daily activities or after more important physical loading. Thus it may also occur after SMT, despite the fact that the chiropractor met his professional standard of care. Case law has established that a conservative course of treatment should be established for the first two or three days before commencing SMT. Patients must be informed of the risks associated with SMT, including disc herniation and CES but these risks must be put in perspective by informing the patient of their incidence. Chiropractors also have the duty to advise on risks of other common treatments such as non-steroidal anti-inflammatory drugs. As a general matter, inherent risks of SMT are best managed by thorough patient management and documentation of counseling on a procedure's risks.

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